Missouri Department of Natural Resources
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3000 Gallon Per Day No-Discharge Permit Exemption for Wastewater

Environmental Assistance Office technical bulletin 7/2004

Small, no-discharge, wastewater treatment systems may be eligible for permit exemptions. The exemption may be available to facilities that generate domestic wastewater (bathroom and kitchen sinks, toilets, showers, laundry, etc.) at a rate less than 3000 gallons per day. Wastewater may not be discharged from the property.

What is a "no-discharge" wastewater system?

A no-discharge facility is one that is designed, constructed, and operated to hold or irrigate, without discharging to surface or ground waters, all wastewater and storm water flows generated by the facility it serves.

This can be performed by various methods, such as:

- Wastewater storage in a holding facility, followed by pump out and transport to a permitted wastewater treatment facility. If your facility will use this method to dispose of wastewater, please contact the Department of Health and Senior Services (DHSS) to determine if a permit is required. Please note that daycare facilities regulated by DHSS are not eligible for this method of wastewater disposal.
- Wastewater treatment in a lagoon followed by land application. No wastewater may be discharged from the property. The lagoon may be preceded by a septic tank.

This technical bulletin describes the site and system requirements to apply for the 3000-gallon per day no-discharge construction or operating permit exemptions for a system using a lagoon for wastewater treatment followed by land application.

Additional requirements for this option include:

- Wastewater cannot be land applied during frozen, snow covered, or saturated soil conditions.
- The storage lagoon must be sealed in accordance with 10 CSR 20-8 and there can be no subsurface releases in violation of 10 CSR 20-7.015 or section 577.155, RSMo.

How do I determine if my proposed system qualifies for an exemption?

STEP 1

Request a geohydrologic evaluation of the proposed lagoon site from the Missouri Department of Natural Resources' Geological Survey and Resource Assessment Division (GSRAD). This evaluation is performed by the department free of charge, but must be requested by completing a request form provided by the department. The form, titled *Request for Geohydrologic Evaluation of Liquid-Waste Treatment Facility/Site*, can be downloaded from the department's Web site (www.dnr.mo.gov/geology/geosrv/forms.htm) or is available upon request by writing or calling the Environmental Geology Section, Geological Survey Program, P.O. Box 250, Rolla, MO 65402-0250, (573) 368-2161 or 1-800-361-4827.

PUB001319

The following information is needed to complete this form:

- A legal description of the property
- Estimated size and operating depth of the lagoon
- Number of acres of land application area
- A note in the comment section stating that you are seeking a permit exemption
- A sketch or topographic map showing:
  - Proposed location of the lagoon
  - Proposed land application area
  - All known wells, springs, sinkholes, caves, and mines within ½ mile of the facility
  - North arrow on the sketch

Sign and return the completed form to the department at the address or fax number at the bottom of the form.

After the department receives the request, a geologist will visit the site if necessary, and prepare a brief report that will be mailed to you and the department's regional office.

Some facilities may be exempted from obtaining a geohydrologic evaluation in areas where bedrock and surficial materials exhibit low overall permeability and collapse potential, groundwater recharge is limited, and soils are suitable for construction of an earthen lagoon. A determination of whether a site meets these criteria will be made by the Geological Survey Program (GSP) based on information provided on the request form and data on file at GSP. A site will be assigned a Slight, Moderate or Severe geologic limitation rating.

- **Slight** geologic limitation rating: Site is eligible for both construction and operating permit exemptions.
- **Moderate** geologic limitation rating: Site's eligibility for a construction permit exemption will be determined on a case-by-case basis; site is eligible for operating permit exemption.
- **Severe** geologic limitation rating: Site is ***not eligible*** for any permit exemption.

Only sites with a Slight or Moderate rating are eligible for the construction permit exemption. You will be notified by letter if your site qualifies for exemption of the geohydrologic evaluation. If a site is classified as Moderate, an exemption will be granted on a case-by-case basis.

STEP 2

If the report from the Geological Survey Program indicates the site has a Severe geologic limitation rating, the site is not eligible for the permit exemption. Please contact the Outreach and Assistance Center at 1-800-361-4827 for information on options available for your site.

If the report from the Geological Survey Program indicates the site has a Slight or Moderate geologic limitation rating, the following information will need to be submitted to the local regional office. Please note however, that if the site is indicated to have a Moderate geologic limitation rating, it may still not be eligible for the construction permit exemption. The local regional office will make that determination on a case-by-case basis.

Required Information:

- A description of the facility. Include the size of the lagoon and the land application site.
- A drawing of the site. Include all property boundaries, buildings, wells, waterways, lagoon, and land application sites. Show all distances on the drawing.
- A copy of the Geohydrologic rating report from GSRAD.
- A copy of the Operation and Maintenance plan.

Regional Office staff will review the request and determine if a permit exemption will be granted for the proposed system. A letter either accepting or denying the request will be sent by mail.

System Design Information

The following information is provided to assist in the sizing, siting, and construction of a no-discharge system.

Locating the Lagoon

Select a lagoon site with a clear sweep of the surrounding area by prevailing winds. Heavy timber should be removed for a distance of at least 50 feet from the water's edge to enhance wind action and prevent shading. Avoid steeply sloping areas.

The lagoon must be located a minimum of:

- 100 feet, and preferably 300 feet, from any water well or water supply structure.
- 50 feet from a stream, water course, lake or impoundment.
- 50 feet from any residence or establishment. The lagoon should be located a minimum of 100 feet from the building(s) that it serves and a minimum of 200 feet from an existing built up area or existing residence.

The lagoon should be located a minimum of:

- 75 feet from property lines, as measured from the lagoon's nearest shoreline.
- 50 feet, and preferably 100 feet, from trees, which may drop leaves, provide shade, or send roots into the lagoon.

Sizing the Lagoon and Land Application Field

In order to size the lagoon, the amount of wastewater flow expected to be produced per day when the facility has reached its maximum loading must be determined. This is known as the design flow, and is shown in gallons per day. The flow expected from a residence is estimated to be about 300 gallons per day. This would represent the flow from a single family home or a single apartment within an apartment building. The flows expected from hotels, restaurants, or other facilities can be determined by using Table 1 of 10 CSR 20-8.020 (11)(B)3.

The lagoon sizes shown in Tables 1 and 2 include storage for all of the flows listed above and rainfall. Tables 1 and 2 also provide the land area required to land apply the amount of wastewater flow. Table 1 uses the recommended 3:1 berm side slopes, while Table 2 uses a side slope of 2:1 for limited property sizes. The lagoon dimensions shown in Tables 1 and 2 refer to Figure 2.

The lagoon must be sized large enough to accommodate the following volumes of water and wastewater:

- There must be sufficient storage volume in the lagoon to store wastewater flows when the soil is saturated or frozen. The storage volume, between the 2-foot operating level and below the maximum operating level, must be at least 90 days, which is the average for climatic conditions in Missouri. The storage volume may be minimal for seasonal use facilities that are not in operation during the winter. Seasonal use facilities must still have a storage volume sufficient to store the wintertime precipitation.
- The lagoon depth must include 2 feet of freeboard above the maximum operating level.
- Additional storage must be provided for the one-in-ten year rainfall minus evaporation for 90 days. This volume of water can be contained using 1 foot of the 2 feet of freeboard.

TABLE 1

FLOW (GPD)	LAGOON DIMENSIONS (L X W) (USING A SIDE SLOPE OF 3:1)				LAND APPLICATION AREA (SQ. FT.)
	SQUARE LAGOON		RECTANGLE LAGOON		
	Bottom L_B X W_B	Berm Top L_T X W_T	Bottom L_B X W_B	Berm Top L_T X W_T	
300	14 X 14	56 X 56	17 X 10	59 X 52	11,200
600	28 X 28	70 X 70	38 X 20	80 X 62	18,500
900	39 X 39	81 X 81	50 X 30	92 X 72	25,810
1200	49 X 49	91 X 91	73 X 30	115 X 72	33,130
1500	57 X 57	99 X 99	86 X 35	128 X 77	40,450
1800	64 X 64	106 X 106	97 X 40	139 X 82	47,770
2100	71 X 71	113 X 113	118 X 40	160 X 82	55,100
2400	77 X 77	119 X 119	125 X 45	167 X 87	62,410
2700	83 X 83	125 X 125	138 X 47	180 X 89	69,730
3000	89 X 89	131 X 131	146 X 51	188 X 93	77,050

TABLE 2

FLOW (GPD)	LAGOON DIMENSIONS (FT.) (L X W) (USING A SIDE SLOPE OF 2:1)				LAND APPLICATION AREA (SQ. FT.)
	SQUARE LAGOON		RECTANGLE LAGOON		
	Bottom L_B X W_B	Berm Top L_T X W_T	Bottom L_B X W_B	Berm Top L_T X W_T	
300	21 X 21	49 X 49	32 X 12	60 X 40	11,200
600	35 X 35	63 X 63	51 X 23	79 X 51	18,500
900	46 X 46	74 X 74	60 X 35	88 X 63	25,810
1200	56 X 56	84 X 84	75 X 40	103 X 68	33,130
1500	64 X 64	92 X 92	88 X 45	116 X 73	40,450
1800	71 X 71	99 X 99	99 X 50	127 X 78	47,770
2100	78 X 78	106 X 106	108 X 55	136 X 83	55,100
2400	85 X 85	113 X 113	116 X 60	144 X 88	62,410
2700	91 X 91	119 X 119	123 X 65	151 X 93	69,730
3000	96 X 96	124 X 124	130 X 70	158 X 98	77,050

Constructing the Lagoon

A small bulldozer or steer loader is the best equipment for building a lagoon. Construction must be done during moist soil conditions or the lagoon may leak. It is important to destroy the original soil structure by repeated compaction and/or disking with rubber-tired equipment, such as a wheel tractor or with a sheepsfoot roller, to assure an adequate seal in the clay liner on the lagoon bottom. Where soils are too gravelly to provide an adequate seal, an artificial liner may be used, or clay soil may be brought in, to create a seal.

Figures 1 and 2 provide details on many of the desired construction features. Round, square, or rectangular lagoons with rounded inside corners are most desirable. Lagoon length should not be more than three times its width and no islands, coves, or peninsulas are permitted.

Figure 1

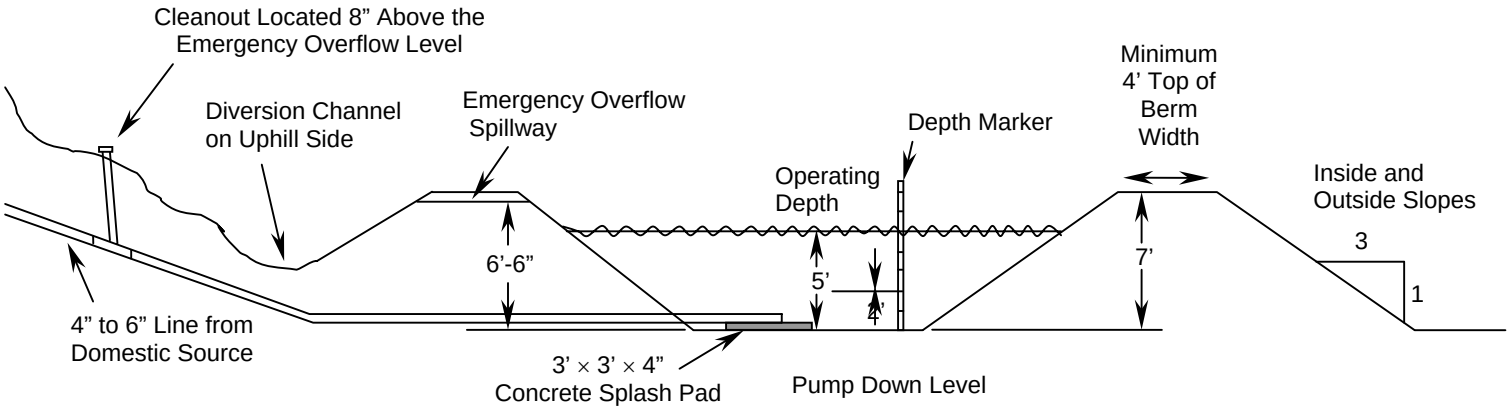
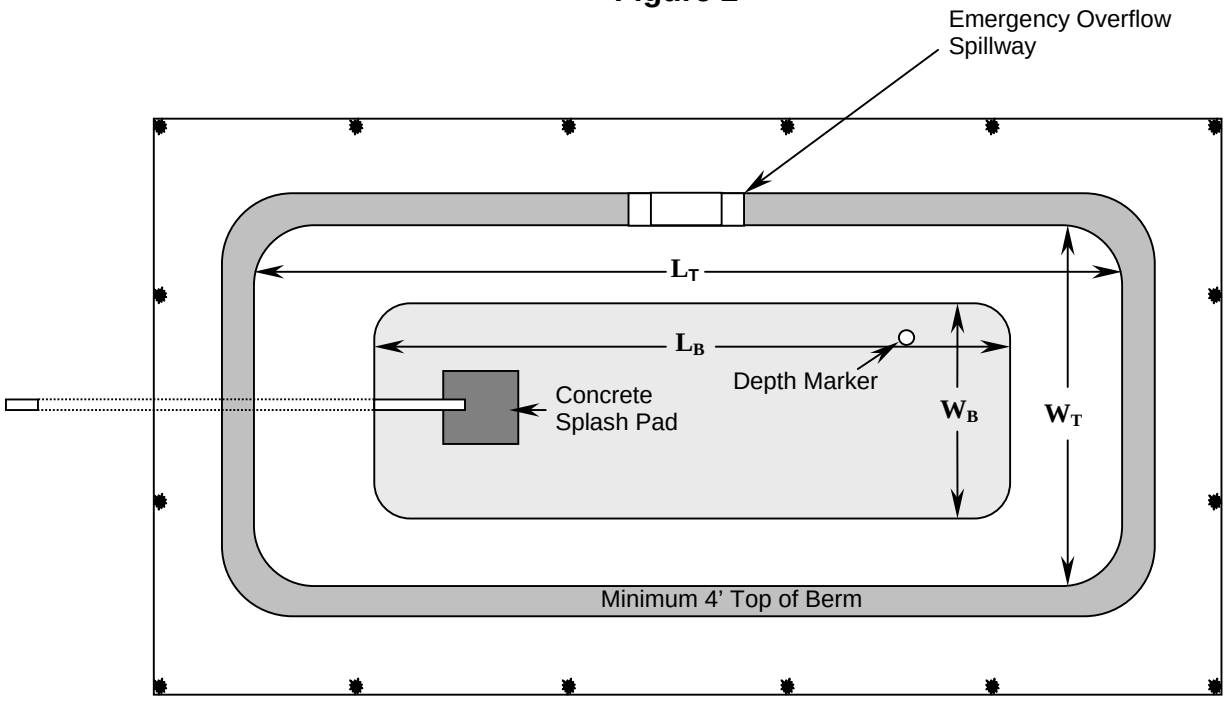


Figure 2



Rectangular Lagoon Shown

A terrace should be placed above the lagoon to divert surface water around the lagoon. It is recommended that a uniform 3:1 or flatter slope be used on the inner and outer lagoon banks and any terraces so that vegetation can be easily mowed. However, steeper slopes, up to 2:1 on the inner slopes, are allowable when site conditions are limited. Provide an outer berm height of at least 2 feet to prevent surface water from entering the lagoon. The lagoon banks must be at least 4 feet wide on top.

Establish good vegetative cover on lagoon banks as soon as possible after construction. Do not use alfalfa or similar long-rooted crops, which might interfere with the water-holding capacity of the embankment. Riprap may be necessary to provide protection of embankments from erosion.

Use at least SDR 35 (schedule 40 recommended) PVC or other acceptable pipe with a 4-inch minimum diameter for the influent line from the source to the lagoon. Place the pipe in a trench on top of undisturbed earth at a minimum grade of 1/8 inch per foot (1 foot of drop per 100 feet of distance). Provide a cleanout on the influent line near the lagoon bank with the bottom elevation of the cleanout a minimum of 6 inches above the high water level in the lagoon. The influent line should lay on the bottom of the lagoon and discharge onto a concrete splash pad 3 feet square, with the discharge point as far as practical from the outlet side of the lagoon.

If the wastewater source(s) has a garbage grinder, it is best to precede the lagoon, with a watertight septic tank with a minimum 1000-gallon capacity, at each source, to reduce the fats and solids loading on the lagoon.

Install a marker in the lagoon to show the water depth.

Construct an emergency spillway on the cut-face of the lagoon by making a slight depression (approximately 6 inches deep and 2-to-3 feet wide) in the top of the berm. Riprap may be necessary to prevent soil erosion if the lagoon discharges in an emergency event. The spillway will allow water to discharge from the lagoon in an emergency situation, thereby helping prevent the berms from eroding if the water level gets too high and flows over the berms.

Enclose the lagoon with a minimum 5-foot high chain link, barbed, welded, or woven wire fence to restrict entry by children, livestock and unauthorized persons. Locate the fence to permit mowing of the lagoon banks. Provide a gate large enough for entry of mowing equipment.

Place a warning sign on each side of the facility. Suggested wording: SEWAGE LAGOON – KEEP OUT. The signs must be made of a durable material with lettering at least 2 inches high and be securely fastened to the fence.

Prefill the lagoon with water to the 2-foot level before putting it into service. Enough water in the lagoon to cover the inlet pipe is essential, and then the lagoon can be filled gradually by incoming wastewater.

Locating the Application Area and Constructing the Irrigation System

The application area must be at least:

- 150 feet from existing dwellings or public use areas, excluding roads or highways.
- 50 feet from the property lines.

- 300 feet from any potable water supply well not located on the property. Adequate protection should be provided for any wells located on the property.
- 300 feet from any sinkhole, losing stream or other geographical feature that may provide a direct connection between the groundwater table and the surface.

Fence the application area if it is accessible by the public.

Use an irrigation system to land apply the wastewater. This can be performed by using a pump with movable sprinklers or by installing a pump and a solid-set sprinkler system. Either system must be designed to handle lagoon effluent.

Operation and Maintenance

Maintenance requires keeping the berms in good condition and fence in good repair, preventing organic debris from entering the lagoon and preventing shading of the lagoon surface.

Regular mowing of the banks from inside the fence to the water's edge will prevent tall grass from drooping into the lagoon where it provides mosquito breeding areas and could contribute to premature filling. Mowing debris should be prevented from entering the lagoon.

It is recommended that trees within at least 50 feet of the lagoon be removed, to keep leaf debris from entering, avoid shading the surface and help control tree roots. Any other vegetation or trees, that shade the lagoon, especially during the winter months, should be removed. Watch for damage to the banks, especially from burrowing animals. Any damage should be repaired immediately and reseeded with grass as needed. Cattails or other vegetation, including duckweed and floating algae masses, should be removed from the lagoon immediately to minimize mosquito breeding and excess organic loading, and to improve oxygen transfer. To help reduce damage to the banks, the fence should be kept in good repair so animals cannot get on the embankments.

Operation and maintenance also includes land application of the wastewater. Once the wastewater level in the lagoon reaches the 5-foot water depth, the wastewater must be land applied. The wastewater should be land applied until the level in the lagoon is lowered to the 2-foot water depth. This process should also be performed just before winter, because wastewater cannot be land applied when the ground is frozen or snow covered. In addition, wastewater cannot be land applied when the soil is saturated.

How No-discharge Lagoons Work

Lagoons are earthen basins for the biological treatment of wastewater. Microorganisms break down wastes in sewage, and oxygen is required for the microorganisms to treat the sewage. Algae, which give the lagoon its green color, produce part of the oxygen. Another source of oxygen occurs at the water surface where oxygen enters from the atmosphere. This exchange is enhanced substantially when the wind is blowing.

Sunlight is essential for algae to produce oxygen; therefore the lagoon surface should not be shaded. Bacteria and other organisms consume oxygen and give off carbon dioxide, which is used by algae in their growth. In a properly constructed lagoon, solids are distributed over such a large area that it should take at least 10 years before sludge removal is required. The presence of trees, water vegetation, fish, animals and waterfowl in or near the lagoon will contribute to the need for more frequent sludge removal.

Properly sized and maintained lagoons usually have little or no odor. However, during spring and fall turnover in lagoons, odors may be present for a few days. Odors are also likely when the natural biological system is upset. This can be caused by overloading, chemicals entering the system which disrupt the natural processes, or extended cloudy weather, especially in spring.

Odors most commonly develop when lagoon contents become anaerobic, or septic. This may occur during extended periods of cloudy weather or following cold winter weather when algae growth is reduced. When the weather warms up, microbiological activity quickly increases, resulting in reduced oxygen levels and possibly in odors. Broadcasting agricultural sodium nitrate or ammonium nitrate (10-10-10) at the rate of 2-pounds per day over the surface of the lagoon until algae growth turns the lagoon green helps control odors. Odors will disappear during the warm season in a properly constructed and managed lagoon, whether or not fertilizer is added to promote algae growth.

Summary

To qualify for the 3000 gallon per day no-discharge permit exemption you must submit the following to your local Missouri Department of Natural Resources Regional Office:

- a geohydrologic evaluation of the proposed lagoon site prepared by the Missouri Department of Natural Resources' Geological Survey and Resource Assessment Division.
- a letter describing the facility that will be served and the no-discharge system, including the estimated wastewater flow, size of lagoon, and land application site.
- a drawing of the site showing all property boundaries, buildings, wells, waterways, lagoon, and land application site. Distances must be shown on the drawing.
- a summary of how the system will be operated and maintained.

For More Information Contact

Department of Natural Resources
Environmental Assistance Office
P.O. Box 176
Jefferson City, MO 65102-0176
1-800-361-4827 or (573) 526-6627
www.dnr.mo.gov/oac/env_assistance.htm